Shoreland Development, Habitat and Water Quality

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Topics:

Eutrophication

- Background & Scope
- Impacts of Shoreland Development

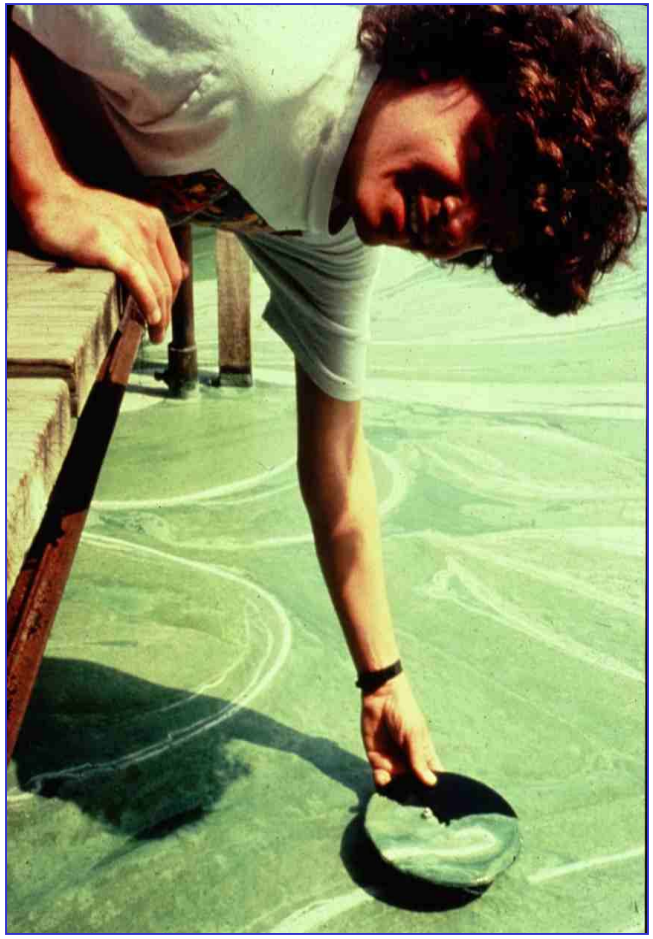
Habitat

Exotics

Summary

Eutrophication
is the over-fertilization of
lakes and rivers with fertilizers,
especially phosphorus

Consequences of Eutrophication:



Blooms of noxious, toxic algae

Oxygen depletion, fish kills

Disease, toxicity

Increased costs of water purification for drinking and other uses

Loss of benefits from fishing, recreation

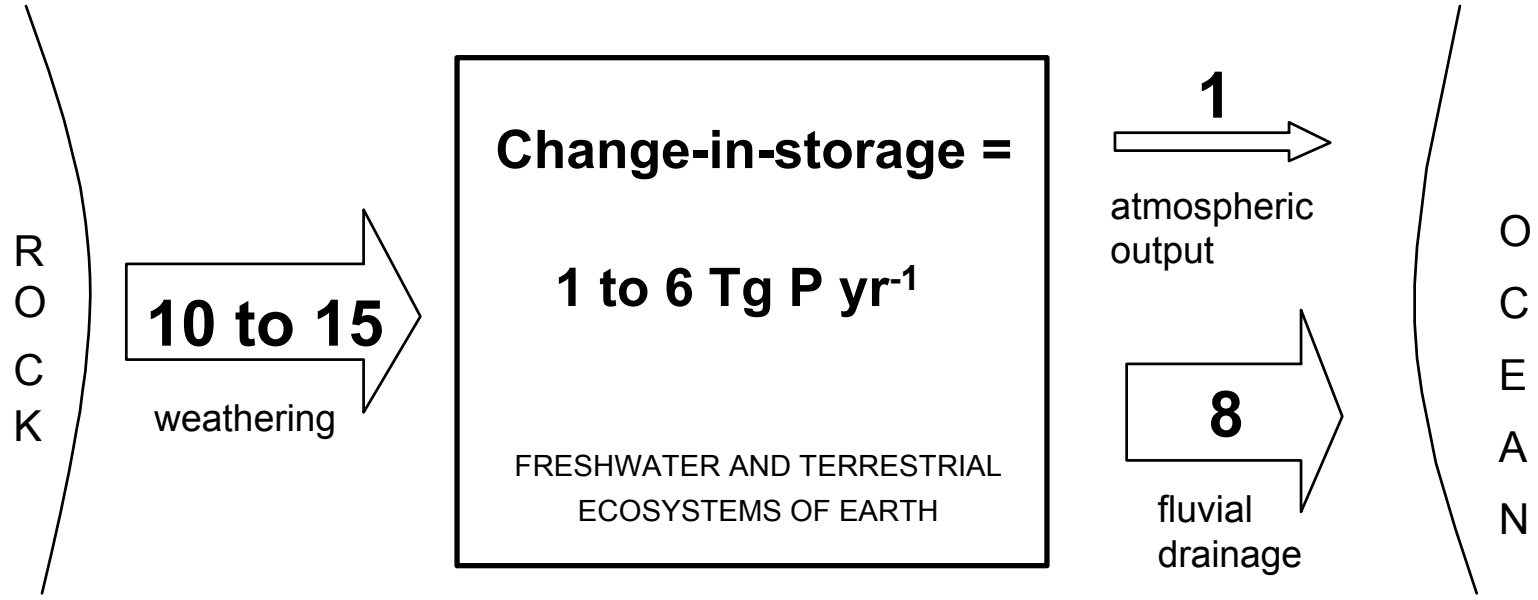
History of Eutrophication in U.S.:

Eutrophication occurred in regions with rich soils shortly after land clearing and start of agriculture (mid – 1800s).

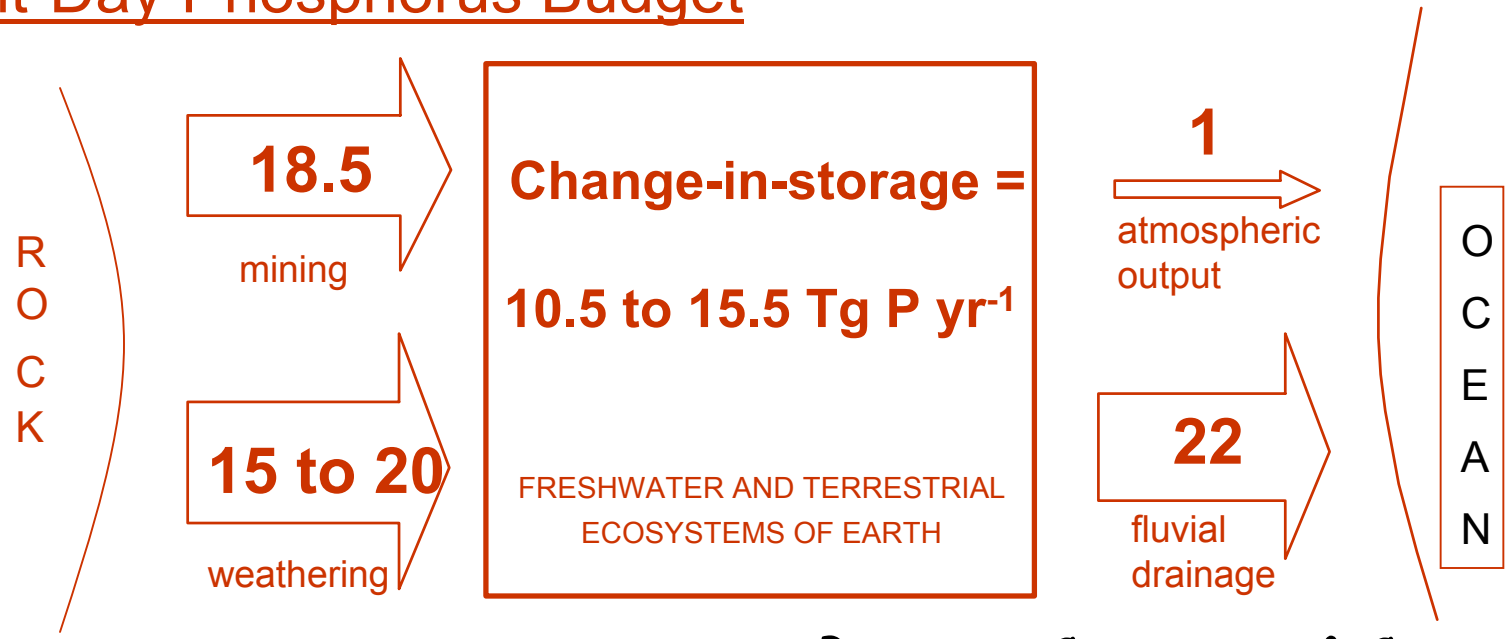
Sewage discharge expanded the problem through mid-1900s

Expansion of commercial fertilizer use began mid-1940s

Ancestral Phosphorus Budget



Present-Day Phosphorus Budget



Bennett, Carpenter & Caraco 2001

WATERSHED PHOSPHORUS BUDGET

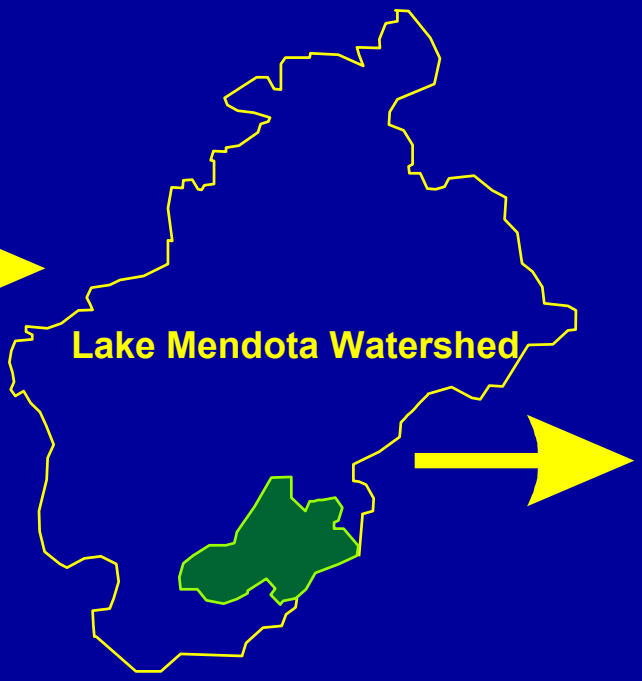
P inputs

Fertilizer for agricultural crops, including:
- corn
- soybeans
- wheat
- oats
- peas and beans
- barley

Feed supplements for dairy cattle

Fertilizer for urban lawn

Dry and wet deposition



P outputs

Crops harvested, including:
- corn
- soybeans
- wheat
- oats
- peas and beans
- barley
- forage

Animal products, including:
- cattle
- hogs/pigs
- milk and dairy
- eggs

Hydrologic exports to Lake Mendota

INPUTS - OUTPUTS = CHANGE IN STORAGE

Source: Bennett et al., 1998

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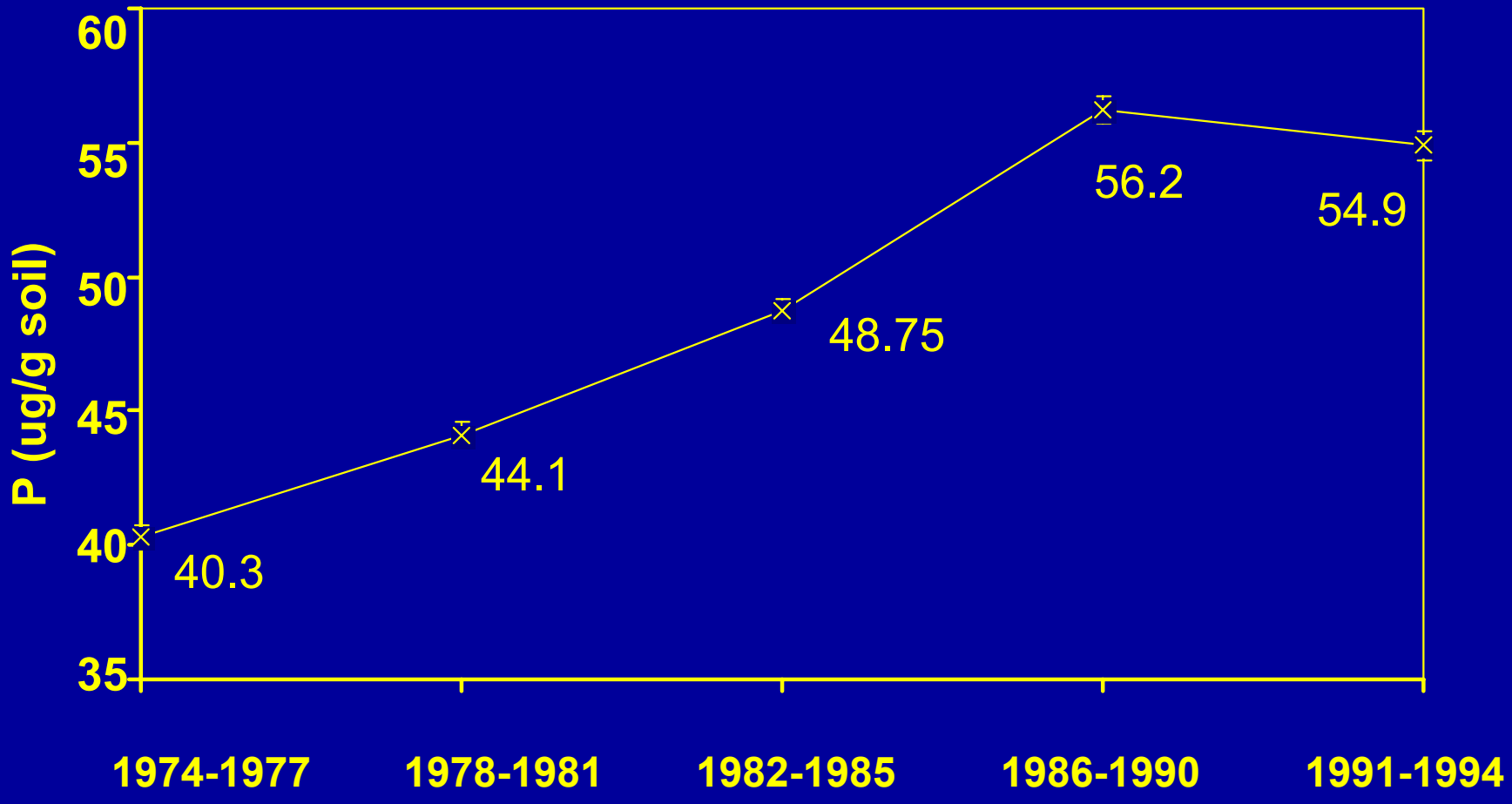
Lake Mendota Watershed: Trends in Soil P

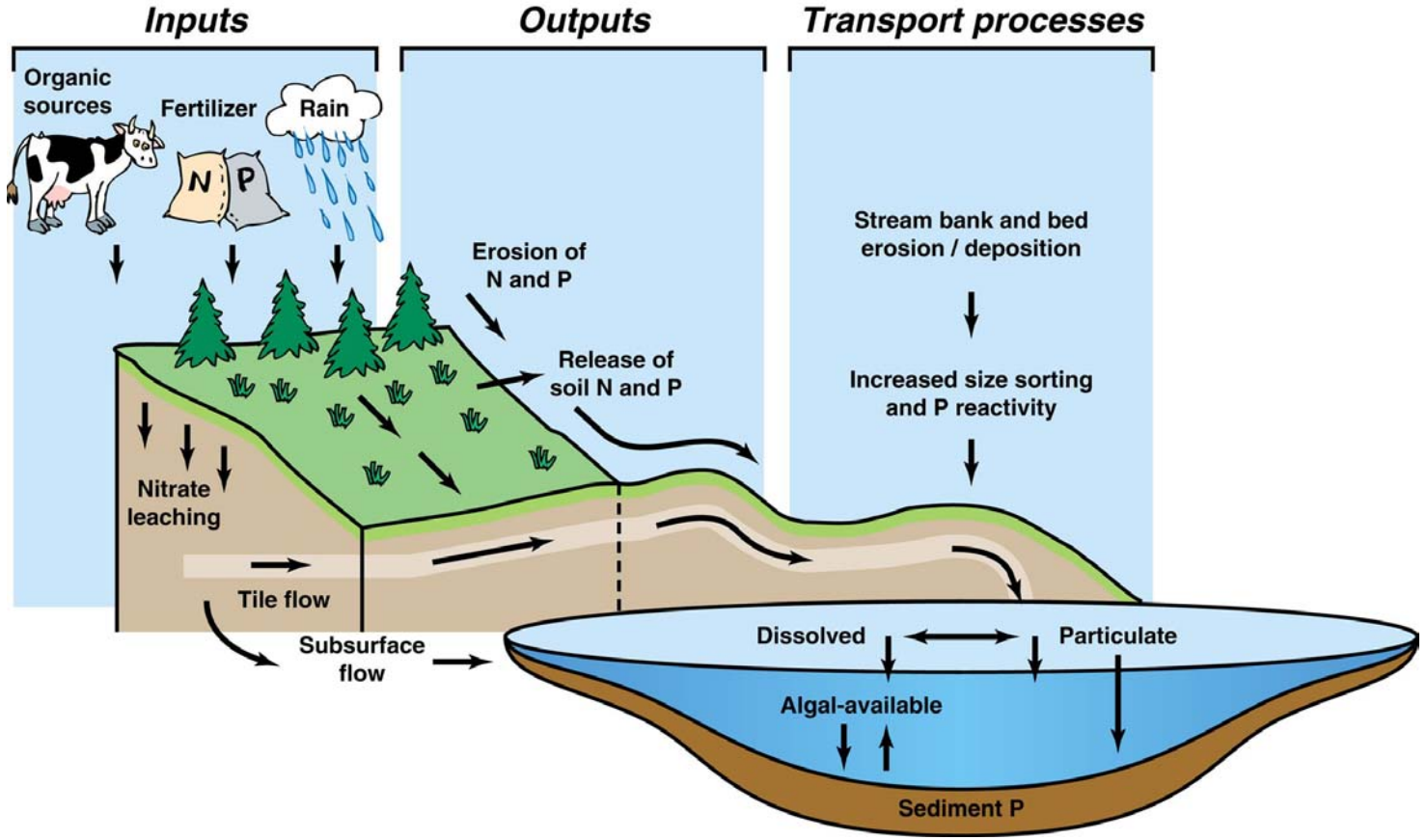


Sources: Combs et al. 1996, Bennett et al., 1998

History of Eutrophication in U.S., continued:

Sewage diversion and treatment increase after ~1950

Nonpoint pollution is the major cause of eutrophication by early 1980s



History of Eutrophication in U.S., continued:

Eutrophication is more severe than ever.

Causes:

- Expanding nonpoint pollution
- Recycling of P from sediments

Complications:

- Hydrologic change due to sprawl
- Exotics: carp, Eurasian milfoil
- Climate change?

No easy answers
to stopping lake pollution

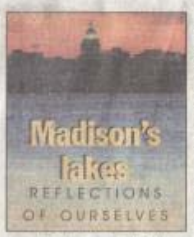
SEDIMENT, PHOSPHORUS BIGGEST PROBLEMS

By Mike Ivey
The Capital Times

If improving water quality in the Madison area lakes were as simple as turning off the pollution spigot, it would have been done long ago.

The problems, unfortunately, are more complicated.

The two major sources of pollution in the five lakes in the Yahara watershed are: sediment, which contributes to the premature filling of the lake bottom, and phosphorus, an essential element for plant life but a major cause of algae blooms and excessive weed growth.



But the two are also intimately linked, as phosphorus attaches itself to soil, which provides the vehicle to carry the plant-enriching chemical into the waterways.

Just about everybody who lives in the watershed is contributing to the problem — farmers dumping phos-

Shoreland Development Affects Eutrophication:

Recreation, nature lead homeowners to water

Moved from Atlanta: Frank and Catherine Clark with their sons, Hampton, 7, and families realizing their dream of living by a lake. In this case, it's Lake Oconee near

USA TODAY

NO. 1 IN THE USA

Wednesday, August 7, 2002

Growing number of U.S. families are revitalizing their lives — as well as counties — by moving closer to lakes

Cover story

By Larry Copeland
USA TODAY

GREENSBORO, Ga. — Frank and Catherine Clark had lived in Atlanta for more than a decade when they got fed up with city living: The traffic congestion. The high costs and long waiting lists at good private schools. And, critical for him, the near-impossibility of getting into a desirable golf club.

They started looking around and settled here, 75 miles east of Atlanta. Catherine Clark, a flight attendant, says her commute to Hartsfield Atlanta International Airport takes only 10 minutes longer. Their sons, Hampton, 7, and Palmer, 5, can attend private schools costing one-third to one-half what they would pay in their in-town Atlanta neighborhood of Buckhead. Her husband has four golf courses right in their subdivision.

Perhaps best of all, their house is by a lake. "We're happy. We enjoy this way of life," says Frank Clark, 42, a sales manager for a door company. "People out here have a lot of space. It's kind of retro, 'Let's get back to the way things were 60 years ago.' " Adds Catherine Clark, 39: "My parents say Hampton and Palmer have no idea how good they've got it: fishing in the lake, swimming, doing things most people do on their vacation."

The Clarks are among a growing number of Americans fleeing the confines of the big city for the natural beauty, convenience and recreational allure of lakefront living. Many of these

Please see COVER STORY next page ▶

1937.....

19....

....62

.....1990

Small amounts of phosphorus runoff can cause eutrophication

west

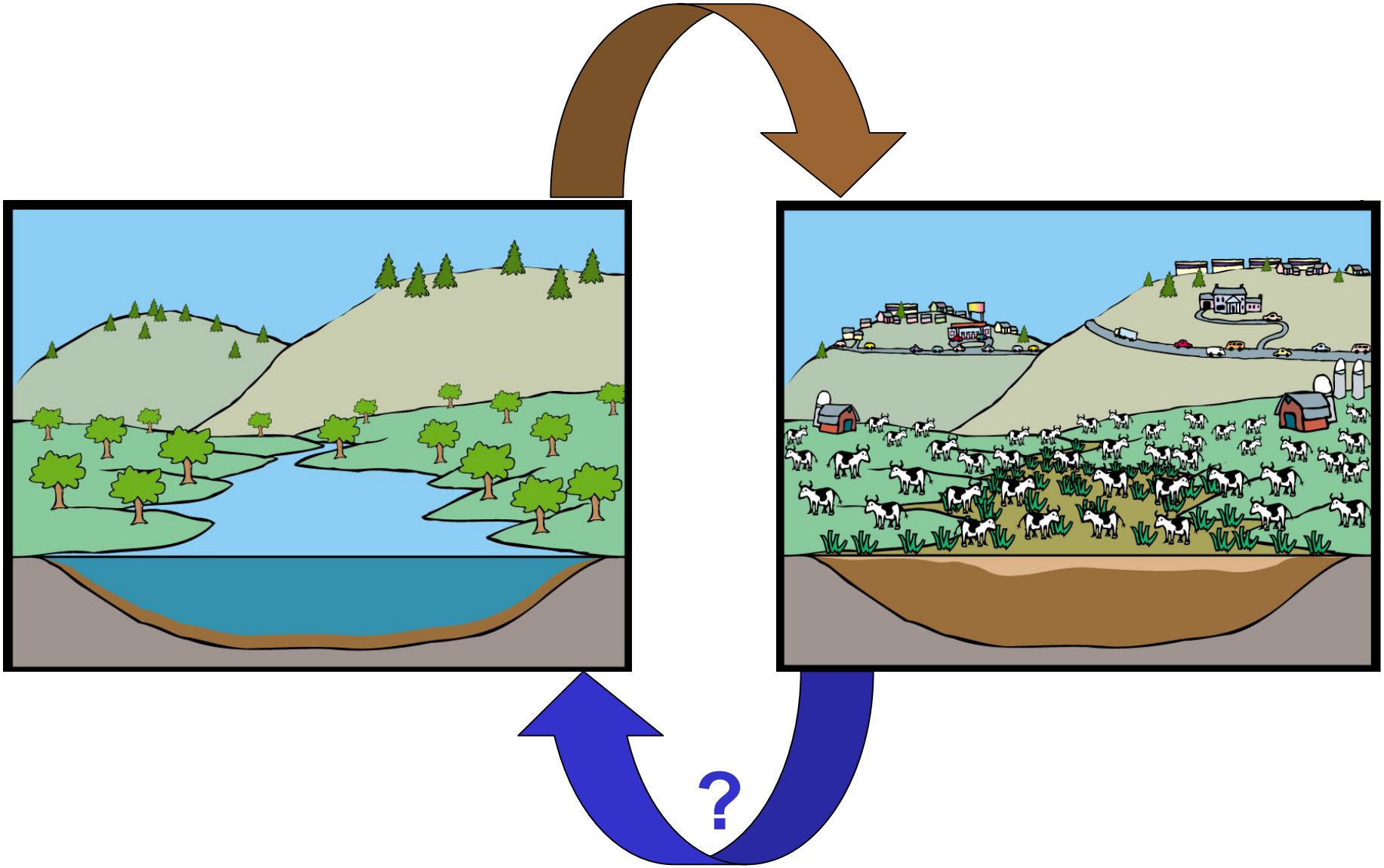
east

west

east

Whole-Lake Experiment near Land o' Lakes, Carpenter et al. 2001

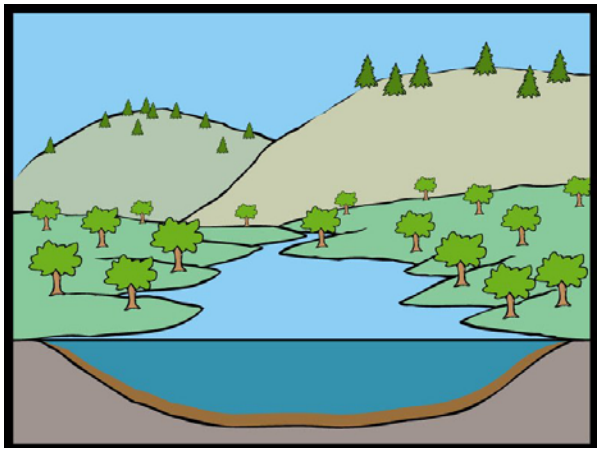
Can eutrophication be reversed?



Clear Water

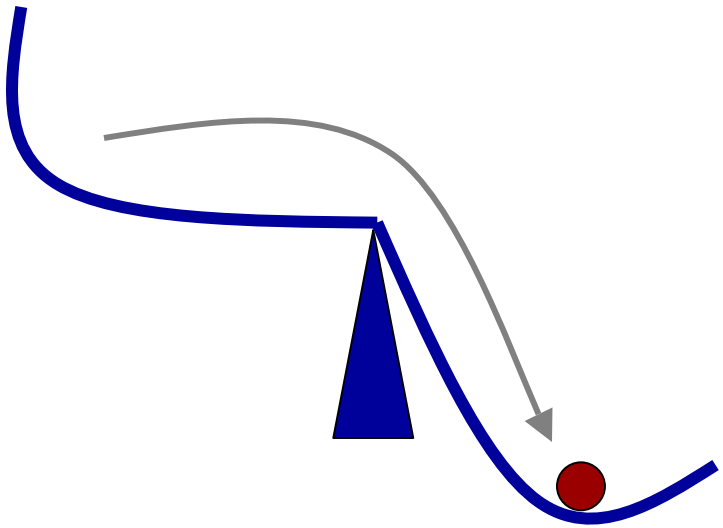
Variable weather

Increase Phosphorus Inputs



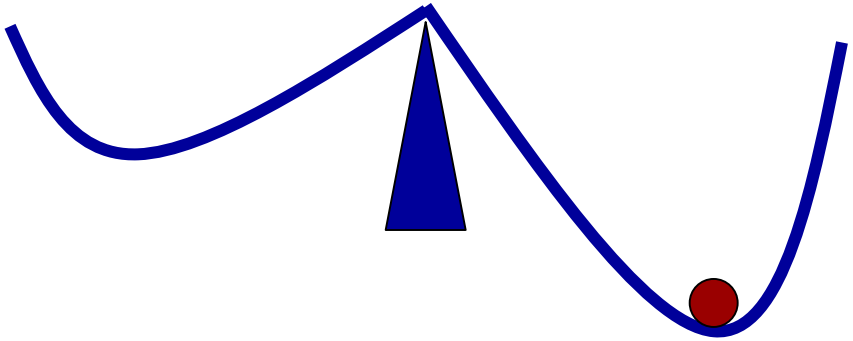
Phosphorus Builds up In Sediments

Buildup of Phosphorus in sediments, plus ongoing input, shifts the lake to the turbid state:



Turbid Water

Phosphorus buildup in sediments makes the turbid state permanent



Toxic Algae Bloom

Fish kill

Key Points About Eutrophication

It is getting worse.

Agricultural and urban + suburban runoff are primary causes.

Slow buildup of P in sediments creates an accident waiting to happen. Often no one sees it coming.

Reversing eutrophication is difficult and slow. Failures are more common than successes.

What can we do about eutrophication?

Prevention is cheaper than restoration.

Balance farm P budgets.

Reduce urban + suburban fertilizer use and P runoff.

Eliminate P fertilizer use in shoreland areas.

Minimize soil disturbance and erosion in shoreland areas.

Restore shoreland vegetation to reduce nutrient and sediment flow to streams and lakes.

Topics:

Eutrophication

- History
- Impacts of Shoreland Development

Habitat

Exotics

Summary

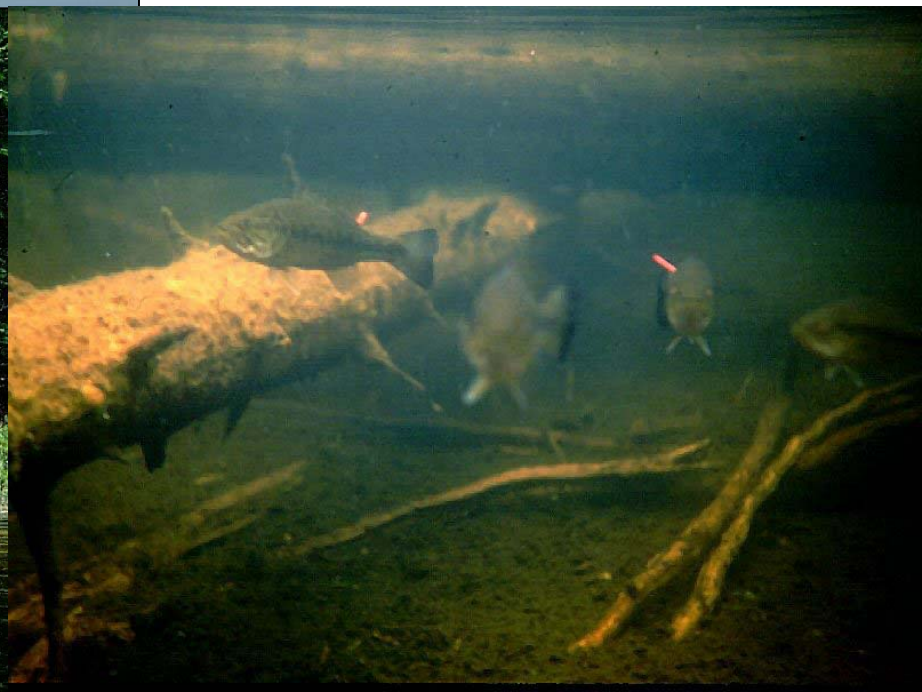
Trees

↓

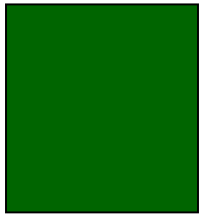
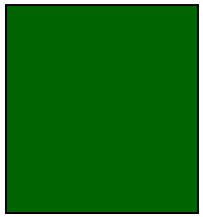
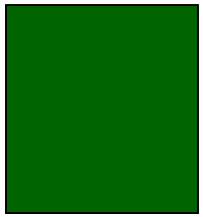
Woody Habitat

↓

Fish



Comparison of Shorelines in Northern Highlands

	Forest Only	Houses, with or without trees
Fish Habitat		
Bluegill Growth Rate		
Largemouth Bass Growth Rate		

What to do about it?

Grow shoreline vegetation to grow fish.

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Example of invasions: Cylindrospermopsis raceborskii

Highly toxic cyanobacterium – nerve and liver toxins, and it makes them all the time

Grows best in eutrophic lakes

Invading in midwest from subtropics:

Boat traffic? Eutrophication? Climate warming?

Example of invasions: rusty crayfish

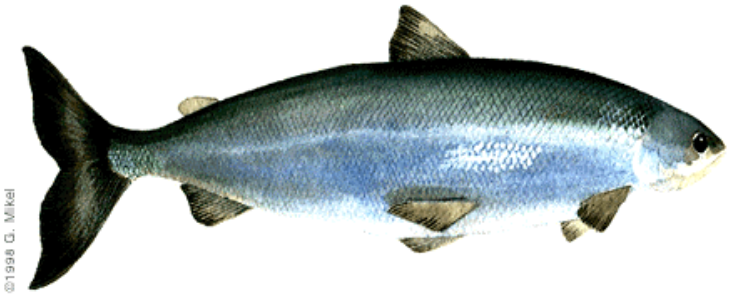
Decrease in native crayfish

Rusties eat fish eggs

Rusties eat aquatic plants that fish need for shelter and places to feed

Example of invasions: rainbow smelt

Loss of lake herring (2 – 4 years)



Loss of walleyes (5 – 10 years)

Are lakes with depleted fisheries vulnerable to invasion?

If so, we might turn the tide by

* Building up the fishery
* Harvesting the invader

Sparkling Lake experiment:

* trophy fishing regulations
* stocking game fish
* intense trapping of rusty crayfish
* intense gill netting of rainbow smelt
* results available 2005

Stay tuned: http://biocomplexity.limnology.wisc.edu

What can we do about exotics?

Prevention is the best policy

Chemical treatments have serious side effects, and some have low success rates.

Biological control in the future for some invaders?

Wisconsin needs an effective policy to stop aquatic invasions.

- Quarantine infested lakes?
- On non-infested lakes:
  - Close landings?
  - Require disinfection of boats before launch?

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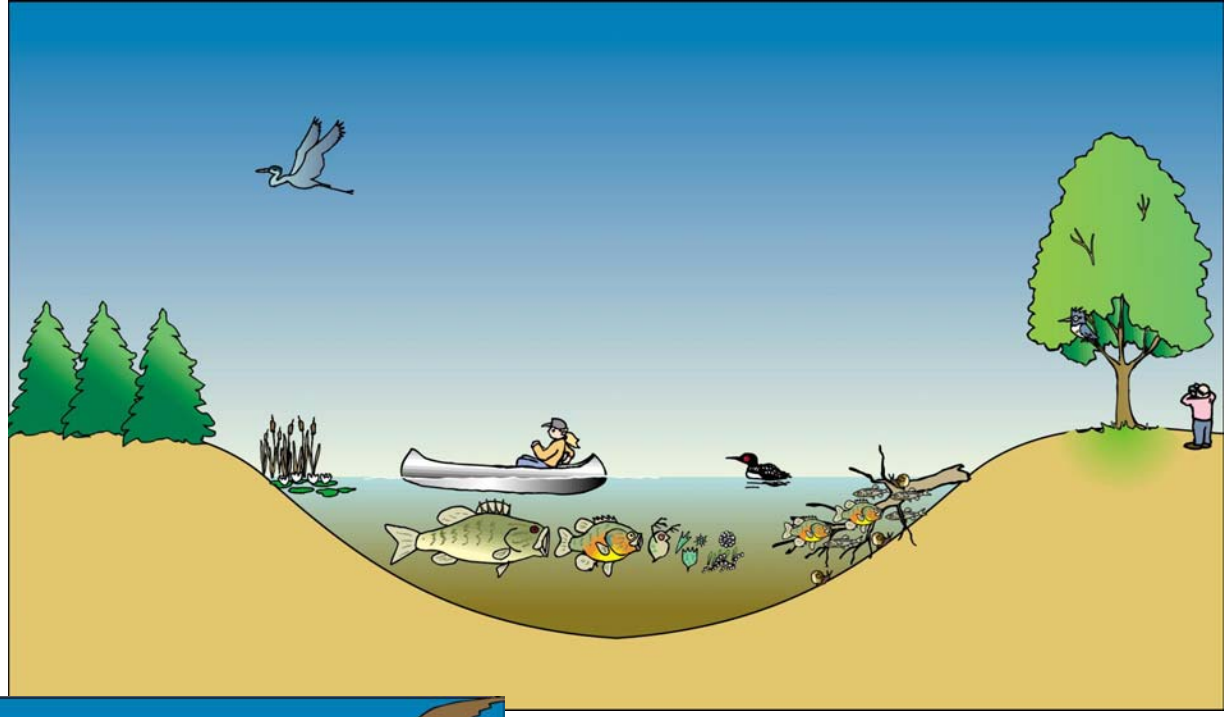
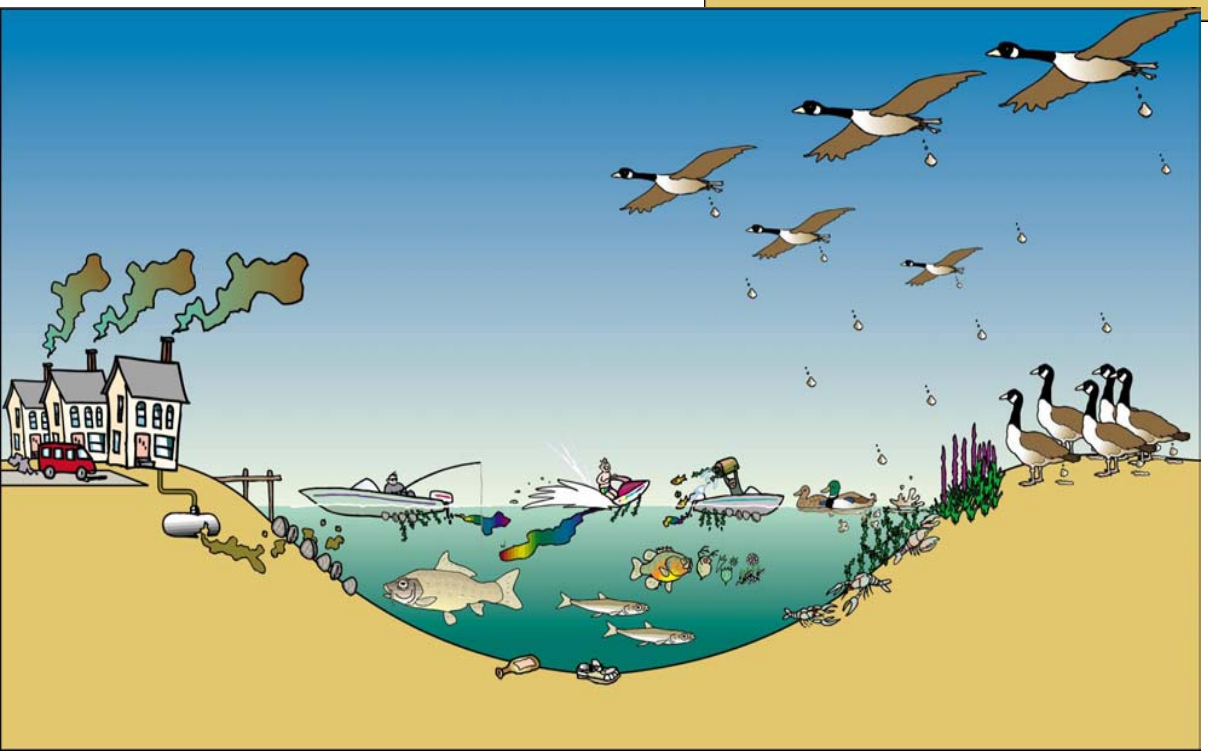
A lake reflects its shoreland . . .





Healthy shoreland makes healthy lakes

The problems are coming faster now.

Before we can deal with today's problem,
the next one comes along.

Repairs are costly, sometimes impossible.

Eutrophication is self-maintaining and expensive
(sometimes impossible) to reverse.

Habitat replacement takes centuries.

Exotics last a long time.

Most of the problems are preventable

Prevention is good policy.

Some Preventive steps:

Eutrophication -

Balance phosphorus budgets (less fertilizer)

Maintain / build riparian vegetation

Habitat -

Maintain / build riparian vegetation

Exotics -

Keep them out.

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